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Learning systems development for the classroom teacher.

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LEARNING SYSTEMS DEVELOPMENT

FOR THE CLASSROOM TEACHER

A Dissertation Presented

by

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This study deals with ways of enabling classroom teachers to use learning systems development techniques to create learning environments. Little work has been done to date relative to this problem, since most learning systems development efforts have been concerned with entities other than the classroom teacher.

The vehicle chosen to solve the problem of "how teachers could use learning systems development techniques to create relevant and effective learning environments for their students" was to develop a "methodology" following guidelines of Thomas Hutchinson (Thomann, 1973). The methodology was developed and tested with a series of teachers. The methodology was revised following each testing until proved effective.

The results of the methodology, to date, have been most successful. In essence, it is possible to conclude that teachers are able, using the methodology, to learn the skills necessary for learning systems development and to develop instruction using the learning systems development skills.

More work remains to be done to help teachers implement learning systems development-based instruction in the classroom, which is the stopping point of this particular study. However, the next series of questions, realtive to implementation, are identified for continuation of this study.

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CHAPTER I

STATEMENT OF THE PROBLEM

Change! Innovation! Alternatives! Relevancy! Individualization! Many exciting things are happening in education that affect how teachers develop instruction. But most of these new approaches, theories, and programs that affect instruction are only tried in a few experimental schools with a great deal of drum-beating and loud proclamations of "the wave of the future in education." When the experimental program ends so does the outside money and the necessary impetus and input from hordes of outside experts most of the time. For another school district to try one of the experimental programs, the first requirement is usually to locate money to buy the available commerical materials and/or the required series of consultants and experts necessary to install the program.

The constraints described above make almost any new instructional program self-limiting to only a few school districts. This is because of the constraints of (1) district adoption, either district-wide or in a few experimental classrooms, (2) outside money, and (3) outside consultants. As long as these constraints exist, it is unlikely that a classroom teacher will be able to utilize a new approach based on his or her own volition. However, the systems approach to development instruction has proved so effective, where used, that an attempt should be instituted to make this approach available to the single unit classroom teacher.

The learning systems approach is basically a way of developing efficient, student-centered instruction that is proven effective. The benefits include:

Student-centered instruction. The instruction developed is all based on an analysis of student needs. It is not possible to have student-centered instruction unless what the student needs to learn, why the student needs to learn it, and how the student can best learn it are discovered. The student is always kept in mind when developing instruction. His needs are identified, instruction is tailored to his needs, and mechanisms are incorporated to change instruction as student needs change.

Efficient instruction. Efficiency is used in a humanistic rather than a mechanistic context. Instruction that wastes time, is boring, is confusing, or is irrelevant is deemed inefficient when applying the systems approach to learning. Procedures are built in to the systems approach to insure that all instruction is based on identified student needs, thereby assuring relevancy. Also, pretesting is an integral part of the process so that students are taught only material they do not already know. The process encourages individualization, self-pacing or other approaches to allow students to proceed at their own rate of learning rather than someone else's. Learning unknown material and self-pacing reduce boredom and wasted time.

Effective instruction. Instruction is deemed effective when it is possible to prove that the instruction teaches what it says that it teaches. Behavioral objectives and criterion-referenced test items are

developed from an analysis of student needs. These objectives, as measured by the criterion-referenced test items, become the standards of the program since the student behavior is identified, the conditions under which the behavior is to be performed are listed, and the standard of performance is included for each objective. With this degree of specificity, it is possible to measure whether or not the objective has been accomplished. If it has not been accomplished by a student, remediation can be provided. If a significant portion of the class (10-30%) has trouble with the objective, then the presentation or instructional materials are weak at that point and should be revised or replaced. Through the process of feedback, based on tryouts of materials, presentations and approaches, it is possible to develop an extremely effective course, i.e., the students do indeed learn what the course purports to teach.

The learning systems approach differs in many ways from the usual approaches employed by teachers in developing their instruction. The most significant differences are in thoroughness and detail, however, rather than in gross procedures. For example, most teachers will give some time and effort to outlining course content; but their outline is usually derived from the teacher's viewpoint (or text format) rather than from a thorough analysis of student needs. So the one step of outlining, performed by most teachers, expands to the performance of a needs analysis and task analysis. Then, instead of using an outline showing topics to be taught <u>to</u> the student, the teacher must develop behavioral objectives and criterion-referenced test items that show the

behaviors to be learned by the students. To perform the kinds of analysis called for, to write behavioral objectives and criterion-referenced test items, to utilize the wide variety of media necessary for consideration in an approach such as this, to understand and operate effectively in a criterion-referenced evaluation program and to understand how all of the components fit together in a logical process requires the internalization of many new skills and concepts by teachers.

In the past those developing instructional programs were simply unable to utilize the learning systems approach without outside resources and experts. The Air Force maintained teams of experts on each of its major training bases to work with course personnel in "systemizing" instruction. Commercial projects such as PLAN (Planned Learning According to Need) cost a great deal of money and require the use of outside experts. Even an internally-developed program such as SPPED (System for Pupil and Program Evaluation and Development), which is being developed by the State Education Department of New York, requires large expenditures of money at the state level to develop the materials and significant expenditures at the local level for training of Local Program Managers, teachers, time lost from teaching, and computer costs.

A major reason that almost all efforts, up to the present, to use the learning systems approach have required the use of outside money and personnel is due to the seeming lack of effort to look at the problem from the viewpoint of a teacher. Theories, methodologies and approaches all are written for "teams" of experts and not for the teacher who has limited time and energy--after all, something has to be taught in the

classroom even while the course is undergoing revision.

To make the learning systems approach available to classroom teachers one must develop a methodology (a step-by-step laying out of procedures that have been tested and revised until proven effective). Two approaches could be taken to develop this methodology. One would be to revise existing systems approaches for the classroom teacher. A second would be to state the purpose for the methodology and start from the beginning with the assumption that if the systems approach is desirable it will be reflected in the methodology developed.

The second approach seems far preferable, since preconceptions and given "truths" are not built into the methodology but are included only on their merits (as presented by Thomas Hutchinson in his emerging Methodology of Developing a Methodology). Consequently, it is proposed to briefly outline a general methodology for the purpose of creating a learning environment. This general methodology will be outlined in the second chapter of the dissertation and will serve as an umbrella concept for the primary focus of the dissertation, which will be the development of a methodology for the purpose of teachers creating a learning environment for students. The general methodology will be presented as a point of departure, and the specific application to teachers will make more sense when contrasted to a more general and idealistic conceptual framework.

Another factor to consider for implementation of the methodology is training teachers to use this methodology. Explication of the methodology is not sufficient in and of itself. Teachers must learn the skills

required to make the methodology operational.

Three methods seem possible for training. The first is at the college level and could be accomplished through undergraduate or graduate courses. The second is regional workshops, and the third method of training is through the use of self-instructional materials. This is important, but must necessarily be a follow-up to the methodological development and, consequently, will not be treated in the dissertation.

A preliminary form of a methodology for teachers to create a learning environment for students already exists and has been tried out and revised at the college classroom level. This methodology still resembles the systems approach, but it has undergone subtle changes that render it more useful for the classroom teacher; for instance, the process may take many years of revision to complete rather than the usual massive all-at-once upheaval. Indications are that the methodology, even in its present form, is achieving the desired results. Teachers are able to understand the approach, develop instruction based on the approach, and (in limited instances) implement the instruction and evaluate its success. The instruction these newly trained teachers are developing is teaching more, to more interested students who are achieving higher grades, based on subjective data collected to date.

CHAPTER II

INTRODUCTION

An overview of many points of view in terms of background and setting for learning systems development will be presented in this chapter. A potpourri of information will be provided as an introduction and orientation for the presentation, in later chapters, of a methodology for teachers to create a learning environment for students. This potpourri of information will include the scope of this paper, a comparison of the learning systems process to the teaching process, a description of what is meant by learning systems development, some examples of where learning systems development is being used, and an annotated bibliography of some of the writings in the field of learning systems development.

Scope of This Paper

The objective of this study is to develop a methodology which will allow classroom instructors to apply learning systems techniques to their instruction. Therefore, the product will be a carefully laid out methodological series of steps to be followed by teachers. This methodology will be under initial development, so that the final product of this study will require a good deal of future testing, revision, and additions.

The methodology will undergo initial validation and subsequent revision. Present plans call for at least three test and revision cycles. The data collected from these validation tests will be presented to show

the progress made during validation and revision procedures.

The ultimate objective of the methodology is for all teachers who are to use learning systems techniques to be able to successfully use the methodology. During this initial development stage, success will be for any teachers to successfully use the methodology. In essence, the hypothesis (in a literal rather than statistical sense) is that classroom teachers, without outside resources, consultants, or the express aid of the school district, can apply learning systems development techniques. A methodology is being produced for teachers to follow for this express purpose. If only one teacher out of a group is successful, then the hypothesis is proven correct. If a small group out of a large group is successful, then the proof is stronger. Once the hypothesis is proved, the next task (one for a later study) is to improve and refine the methodology until all teachers who use the methodology are successful.

To summarize, a methodology will be produced. This methodology will enable classroom teachers to apply learning systems development techniques to the development of their instruction. At this early stage of development, the criterion for success is that one teacher be able to satisfactorily use the methodology. No attempt will be made to include any instructional materials, directions or other aids along with the methodology.

Learning Systems Process Contrasted to Teaching Process

The methodology being developed is for use by teachers. However,

it is important to differentiate between activities performed by most teachers in a day-to-day type of interaction with students (and others) and the type of planning activities performed by teachers, since it is mostly these planning activities that are included in learning systems development.

Let's first look at the teaching process. It is not really possible to come to a consensus of any sort on exactly what the job of a teacher entails. It is possible, however, to examine various major, and different, roles played by a classroom instructor. The most obvious and familiar role is the one which will be considered here as "the teacher." The teacher, as students see him or her, presents lessons, talks with them, gives directions, motivates, diagnoses problems of individuals or of the class as a whole, disciplines, rewards and punishes. In short, "the teacher" is acting in an interactive mode and must use many skills, both learned and intuitive, to function in this interactive environment. It is necessary to decide when to push a student harder, when to praise feeble efforts, when to step out of the way of a prodigy, and when to discipline a lazy student.

The activities mentioned above are all recognizable to anyone who has attended school. They are the activities most readily identified with "teaching" by the layman. Hence, these activities will be labeled as the teaching process.

Let's next look at the learning systems development process. In essence, these activities are the planning activities. They consist of determining what to teach, writing course objectives and curriculum

outlines, preparing tests, acquiring instructional materials, relating instructional materials to course objectives, pretesting, validating instruction, and evaluating the entire process.

The learning systems development activities are some of the behind-the-scene duties that teachers are well aware of, but which non-teachers are less likely to know about. However, these activities are a prime requisite for teaching that satisfies student needs; unless adequate planning is done, instruction--no matter how attractively packaged or pleasing from an interactive standpoint--may well teach irrelevant or even detrimental knowledge (i.e., knowledge that must be unlearned).

Mention should be made of evaluation as another major activity of teachers. A great deal of research and interest has gone into this field, and it is possible to define a third teacher role in terms of evaluation. But, since evaluation is also included in the learning systems development (or planner) role, no more time will be spent in delineating the teacher as an evaluator. In essence, the methodology to be developed will include evaluation as a subset of learning systems development.

The methodology which will be presented will deal only with learning systems development activities. The steps in planning instruction prior to classroom interaction with students and the use of data gathered for revision of instruction will be dealt with. The interactive kinds of activities described above as the teaching process will not be dealt with.

Learning Systems Development

The concept of learning systems development will be examined from three different perspectives. A current problem for both learning systems developers and interested laymen is the proliferation of terms being used for the concept of learning systems development. Through interaction and research, once distinct fields such as educational technology, programmed instruction, instructional systems development, and even in many instances curriculum development all purport to use much the same type of "systems" procedures. Scholars in all of the above fields are concerned with semantical similarities and differences. And, even though a review of the literature will show some different viewpoints, biases, or concerns for each of the above groups (Dubenezic, 1971), the similarities greatly outweigh the differences. Consequently, all of these approaches are encompassed under the term "learning systems development."

The three perspectives of looking at the concept of learning systems development are (1) definitions, (2) process, and (3) product.

Definitions. No two writers define the learning systems approach in quite the same way. But they do contain similar notions. A survey of the literature reveals the following definitions of the systems approach to developing instruction:

(1) "Deliberately designed synthetic organisms, comprised of interrelated and interacting components which are employed to function in an integrated fashion to attain

predetermined purposes" (Banathy, 1969, p. 2).

(2) "The sum total of separate parts working independently and in interaction to achieve previously stated objectives" (Kaufman, 1969, p. 419).

(3) "An empirically derived framework which serves as a guide for systematically proceeding toward the solution of some defined problem in the educational industry" (Hamreus, 1970, p. I-4).

(4) "An integrated combination of resources (students, instructors, material, equipment, and facilities), techniques, and procedures performing efficiently the functions required to achieve specified learning objectives" (U.S. Air Force, 1970, p. 1-1).

(5) "a. Goals of the instruction and standards to be attained are identified in terms of learner performance.

"b. Evaluative measures are designed to assess attainment of goals.

"c. Alternative sets of strategies are considered for purposes of selecting materials and methods to be employed.

"d. Design decisions conform to the defined 'inputs'--i.e., to the entering competencies of the intended learners and to the boundary conditions represented

by the human and other resources available for the development and utilization effort" (Briggs, 1970, p. vii).

(6) "a. The requirements or objectives of the system will control the design of the system.

"b. The system will maximize learning effectiveness through procedures such that all, or almost all, of the stated objectives of the system are achieved; i.e., 90 per cent of the students will learn 90 per cent of the material.

"c. The system will maximize learning efficiency by adapting the system to the learner rather than making the learner fit the system.

"d. The design and procedures of the system will reflect an educational philosophy consistent with the requirements of the system and society" (Stewart, 1969, pp. 137-138).

The above definitions are all proposed by writers working in the area of systems relative to education. The first two definitions are of a broad nature that transcends educational applications. These definitions are appropriate to talking about systems applications to management and industry as well as education. The third and fourth definitions begin to show an educational flavor. Even though they are similar to the first two in terms of concepts presented, Hamreus (third

definition) talks of solving an educational problem, and the USAF definition (fourth definition) adds the notions of students, instructors, and learning objectives rather than educational problems. The final two definitions are much more specific and are related to education and no other field. They are almost prescriptive steps to follow. Briggs (fifth definition) actually refers to his statement as a systems approach model rather than a definition. Stewart (sixth definition) calls his statement a definition of the "Learning-Systems Concept" (Stewart, 1969, p. 137).

All of these definitions, from the general systems definitions to the specific applications to education, have common threads that run through them. The first is goals. The systems approach is applied to problem-solving of some sort; therefore the problem must be discovered, analyzed, and clearly explicated. The second is interrelationship of parts. Either stated or implied is a series of steps or interlocking components. These steps/components all affect each other, and any change to one changes all the others. The third common thread is evaluation. Again, this is stated in some definitions but only implied in others. But all indicate that some sort of evaluation, utilized in the form of feedback, is used to make sure that the problem is solved--or, as Stewart states (1969, p. 138): ". . . 90 per cent of the students will learn 90 per cent of the material." Fourth, the educational definitions also mention the notion of student input being a prime concern in developing the system. Fifth is efficiency. While efficiency is only stated outright in definitions four and six, the other authors

would claim it is implied in their definitions also (this assumption is based on the models and descriptions of models of the other authors). It is not enough just to accomplish the stated goal; this accomplishment should be efficient in terms of time, money, emotional investment, and the like. Therefore, if approach "A" will do the job in 30 hours and approach "B" takes 50 hours, approach "A" should be chosen if all other factors are constant. Other considerations include mixtures of approaches (see literature on Aptitude Treatment Interaction or A.T.I.). The only notion contained in the above definitions that cannot be generalized across all of them is Stewart's point "d" relative to educational philosophy. This notion is quite well explained by Tyler (1950) in his book on curriculum development, which occasionally still appears in definitions and curriculum development models. The only point is to make sure that what you do is consistent with what you say you want to do.

As a conclusion to the discussion on definitions of the learning systems approach, Hamreus's (1970) explanation of his definition will be presented. He expands and clarifies the five major notions contained in his definition in a way which provides better clarity than any of the other authors surveyed:

> "Five things in the above statement [Hamreus's definition] should be amplified. First, although the use of the definite article 'the' in the term 'the systems approach' implies a fixed set of operations which consists of a specific content, such an interpretation is false. The actions employed, in using the systems approach to attack a defined instructional problem, follow a general strategy but are not fixed; rather, they change according to the nature of the problem and its context.
>
> "Second, the approach has been <u>empirically</u> derived. It is not a mathematically derived model which has emerged in the sterile environs of the laboratory; but, rather, has evolved, and continues to do so, from real life experiences.

> "Third, the approach serves as a guide in attacking a problem solution; it provides an order whereby decision points critical in the problem solution can be systematically faced and necessary actions decided upon.
>
> "Fourth, the approach provides for a systematic attack on the problem. The problem and all of its elements are thoroughly considered (within the means available) and progress toward a solution regulated.
>
> "Fifth, a problem in the educational industry has been defined. Obviously, before any efforts toward solution can be initiated, the problem must be clearly distinguished" (pp. I-4,5).

The learning systems approach is almost, by definition, a process. The above definitions all talk of interrelated parts, components, and steps to follow. The systems approach, then, is a way to get at a problem. No ready-made solution is provided. Instead, a series of steps or procedures are set down so that the researcher, or teacher, or designer can find his or her own answer to the problem in a logical and efficient manner. Many people, after learning the systems approach, find their way of thinking and even their lives changed due to the order that is provided by the approach.

No hard and fast rules exist forcing systems practitioners to use only one ordering of the steps. However, there is a general ordering which most do use. First is to identify the problem and specify objectives. Second is to set up criterion or evaluation measures to determine accomplishment of the objectives. Third is to measure student characteristics. Fourth is to examine alternative means of accomplishing the objectives, to choose an approach, and to implement the chosen approach (or approaches). The final step is evaluation. How well are all elements of the system operating? What needs to be changed, or revised, or expanded?

The learning systems approach results in a specific type of product. If the approach is properly applied, certain expectations and characteristics should exist in the product. For instance, the final system should accomplish its stated purpose. It should be efficient in terms of time, money, and any other factors built in by the developer. Alternative processes for accomplishing the purpose should be built in. The needs of the users should be met. Also, the system should contain an evaluation component so that the system can change as the needs of its users change. It is possible, therefore, to describe in a general way what the product will be like; if these expectations are not met, then the product of the system is malfunctioning in some manner.

Current Uses of Learning Systems Approaches

Military services. All military services are interested in rapid training of their personnel. The Air Force began to apply systems techniques to their training programs in the 1960's, based on the success experienced with the systems approach in weapons sytems development dating back to World War II. Theorists proposed systems applications in the 1950's. Technicians were trained in the early 1960's. Then, in 1964, Instructional Systems Development Teams were formed on all major Air Training Command training bases. A continual supply of newly trained technicians was supplied from the Instructional Programmers Course at Lackland Air Force Base (note the inconsistency of terms--the Instructional Programmers Course trained people for Instructional Systems Development work).

Two early examples of courses systemized by the Instructional Systems Development Team at Amarillo Air Force Base were the Fuels Course and the Administrative Specialist Course.

The results were rather spectacular. At a time when trained military personnel were needed at an ever-increasing rate during the Vietnam War build-up in the mid-sixties, the Administrative Specialist Course was turning out students in half the time of pre-systemization, and some students were finishing in one-tenth the time previously required. The Fuels Course showed equal time savings, with average student completion time dropping from 43 days to 23 days. The Chief of the Amarillo Instructional Systems Development Team computed the savings to the Air Force to be over one million dollars per year, due to trained personnel reaching the field sooner, savings in salaries of students and instructors, and other related factors.

The systems approach was later applied to flight training courses, with similar results. The first flight training course systemized was reduced in time from 14 hours to 11 hours, with a savings of 76 thousand dollars per year.

Industrial training. An example of systems applications to industrial training is supplied by American Airlines. This example is more exotic than most, but the money and time savings are perhaps even more dramatic due to the nature of the task. Retraining pilots of other aircraft to fly the DC-10 dropped in time from about 162 hours to 31 hours. This included ground training (reduced from four weeks to ten hours), flight simulation (reduced from 22 hours to 18 hours), and flying time

(reduced from 20 hours in comparable aircraft to two and one-half hours).

The spokesman for American Airlines did not care to give dollar savings because of all the variables involved. However, imagining the salary of pilots and the cost of keeping a plane in the air, expenditures which have been converted from dead training time to productive on-the-job time, leaves one feeling that the dollar savings are rather significant.

Commercial impact on public schools. Project PLAN (Planned Learning According to Need) has been capitalized by Westinghouse Learning Corporation in a combined venture with American Institutes for Research and fourteen experimental schools (experimental in the sense that they are using PLAN). A learning systems approach is being used. The major components of PLAN are: (1) a set of educational objectives, (2) learning methods and materials, (3) evaluation, (4) guidance and individual planning, (5) teacher development, and (6) computer services (NCME, January 1971, p. 2).

These components are commercially sold by Westinghouse Learning. The resulting program should (based on the efforts of developers) be based on student needs, be individualized, and allow for great flexibility in the school program. The school district, however, must make a substantial commitment, including: a $5,000 sign-up fee, plus $4,000-$5,000 per year for computer time, plus $6 per month per student for TLU's (Teaching-Learning Units), plus $2.80 per month per student for computer control, plus a minimum of $600 for each teacher trained,

as well as other suggested items such as the institution of differentiated staffing (The Individualized Learning Letter, February 22, 1971, p. 3).

College-level program development. The Amherst Elementary Program is an undergraduate elementary teacher preparation program at the University of Massachusetts. The learning systems development process is used (1) as part of the instructional process taught to undergraduates and (2) as the process of actual program development.

The program is built around satisfying the needs of the undergraduates who are being trained to be teachers (needs of others in the program will also be met as much as possible). Individualization is an integral part of the program, as well as alternative learning materials, a competency base, and continual evaluation and feedback to keep the program sensitive to newly emerging requirements for teachers entering the profession.

Program directors feel that the learning systems approach has greatly helped in terms of organization, specifying program goals, and identifying needs of groups within the program; "in fact, (the program) is far ahead of where (the program) might otherwise have been without (using learning systems development techniques)" (Dr. David Flight, October 4, 1972).

State education department. The New York State Education Department, through the Bureau of School and Cultural Research, has developed a program entitled SPPED (System for Pupil and Program Evaluation and Development). This program provides the support necessary for school

districts to apply learning systems development techniques. SPPED includes training materials to teach teachers and other school district personnel the systems approach to curriculum development, as well as how to use computer banks of objectives (test items and resources will be included in the future) and a computerized criterion-referenced testing system known as CAM (Comprehensive Achievement Monitoring, developed at Stanford University and the University of Massachusetts and incorporated as the evaluation component of SPPED). Consulting services and backup information are provided by the State Education Department.

School districts in New York State have now been using CAM for nearly five years. Many find this to be the most satisfying first step toward the total utilization of SPPED and are now beginning to adopt the rest of the SPPED program. School districts find that SPPED gives them much better definition of what they are teaching, the ability to better articulate and meet student needs, the guidance necessary to individualize, and an evaluation component that allows for much more informed decision-making than their pre-SPPED (or pre-CAM) programs.

The above examples provide a quick look at learning systems applications to education and/or training in a variety of contexts. The purpose of this overview is to convey a feeling for the wide use of learning systems in military, industrial, commercial, college, and government educational programs and to pull out some gains that accrue from applying the systems approach to learning situations.

Gains from applying learning systems in the above situations seem to fall into three major categories: (1) time saved, (2) money saved,

and (3) needs better met. Points (1) and (2) are most dramatically portrayed in the military and industrial examples. Time for students to learn what they had learned previously (or more) was often cut in half, with corresponding savings in training dollars. The last three examples focus more on the fact that using the systems approach better allows for meeting students' needs. However, all three points still apply in all examples. For instance, faster training helped the Air Force provide more trained personnel more quickly, which was a need for the Air Force if not exactly a need of the airmen being trained. The same holds true for American Airlines. Time and money savings, of a sort, exist when greater efficiency is introduced into an instructional situation, such as is provided by the Amherst Elementary Program, PLAN, and SPPED. If more information is taught in less time, then a time savings exists. Also, a money savings exists because a better product (students with greater knowledge) results. There are only paper savings at the present time, because students usually stay in the program for the same amount of time (for about the same number of dollars) as previously. However, these savings of time and money could be converted to real savings by terminating a student in the present program when he or she had learned as much as was expected in the old program. On the average, the termination would occur sooner, thus providing the time and money savings.

Annotated Bibliography of Some of the Writings in the Field

This section will provide an orientation for the study relative to other studies and writings in the area of learning systems development.

It is not intended to be an exhaustive survey of literature. A sampling of some of the best writings available will be presented, followed by a statement of what will be accomplished in this study that others have not already done.

"A Learning-Systems Concept as Applied to Courses in Education and Training," a chapter by Donald K. Stewart from the book Educational Media: Theory into Practice, which was edited by Raymond V. Wiman and Wesley C. Meierhenry, is a short but exceptionally fine analysis of the systems process in education. Stewart challenges the reader, brings out some of the problems and dissatisfactions in today's education, and briefly describes the systems process in education. This chapter is an excellent introduction to stimulate a reader to find out more about learning systems and to provide him with an outline of the process.

Instructional Systems, by Bela Banathy, is a more detailed introduction to the field. He provides specific examples of systems use and presents a global picture of education before describing a step-by-step systems approach. Again, the reader finishes this book with an excellent introduction to learning systems, but he has only the rudiments of systems thinking and no real skills to apply.

Another introduction is provided by Dale Hamreus in The Systems Approach to Instructional Development. He does the best job of defining and explaining the learning systems approach; however, the model he presents is brief and is intended for a team of developers. Items such as selection of support staff and determining management controls clearly indicate the team concept to be used when applying the Hamreus model.

Instructional Systems Development, USAF Manual 50-5, begins to provide step-by-step procedures to be followed when applying the systems approach to instructional development. This manual is written for large teams of experts and is geared to industrial and technical training.

Instructional Design, by Jerrold Kemp, does a good job of setting down systems procedures in a step-by-step fashion. However, the steps are quite brief; the book is written for "potential instructional designers" (Kemp, 1971, p. iv) and suffers from the same problem as Banathy, Briggs, and so many other writers in the field. All imply that something happens prior to writing course objectives, but none of them includes a needs analysis and task analysis of what students must learn with enough detail to allow the reader to actually do a needs analysis and task analysis.

Instructional Product Development, by Baker and Schutz, is the first of the books here indicated to begin using some of the techniques mentioned in the book itself. Objectives and criterion-referenced measures are included for each chapter. The main problem with this book, from the point of view of the teacher, is that the intended audience is someone entering the field of "educational research and development" (Baker & Schutz, 1971, p. v).

The Handbook of Procedures for the Design of Instruction, by Leslie Briggs, is by far the most sophisticated work in terms of using the techniques presented. Objectives, criterion-referenced measures, and alternative learning approaches are provided, as well as sample lessons from past students. This handbook is really a series of

pamphlets, rather than one single book. The problems with the series are twofold. First is the lack of needs analysis and task analysis instruction. Second is the intended audience. The approach is presented at an appropriate level for learning systems developers and educational technologists, rather than for the classroom teacher.

Educational System Planning, by Roger Kaufman, is the only book surveyed that does an adequate job of presenting an approach for analyzing student needs. Also, he includes chapter objectives and criterion-referenced test items. He does not, however, have much detail on the rest of the process; the terminology used is unique to this book; and the approach is probably too complicated and time consuming for the classroom teacher.

The population with which the present study is concerned is the classroom teacher. None of the above-listed works are written for the classroom teacher. Some, such as Banathy and Stewart, do not specify a population. Some simply imply a team of experts, such as the USAF manual and Hamreus. Others are written for specialists, such as Briggs, Kemp, and Baker and Schutz. Also, any field testing of the above books was done on a population other than classroom teachers.

Many of the models and approaches lack components critical to instructional development by classroom teachers. The most obvious pieces that must be added are a needs analysis and a task analysis. Hamreus goes so far as to claim that instruction may even be detrimental if these components are not included, due to the fact that irrelevant information may be taught without the needs analysis.

Finally, the systems approach should be used to teach the learning systems approach. This study will not present instruction, but will develop a methodology (a series of procedures that have been validated) for classroom teachers to follow when applying the learning systems approach. It is doubtful if careful methodological development preceded the writing of the above-mentioned books.

CHAPTER III

METHODOLOGY FOR CREATING A LEARNING ENVIRONMENT

This chapter contains a generalized methodology for creating learning environments. The generalized methodology presented here is applicable to anyone developing instruction for anyone under any circumstances. For anyone to successfully develop instruction or, as is stated in the purpose of the methodology, to create a learning environment, it is necessary to proceed through the steps listed below.

The generalized methodology is presented as a framework within which to present a more specific methodology (methodology for teachers to create learning environments for students) in Chapter VI, which is the product of this study. It is, however, necessary to see what the compromises and revisions of the specific methodology are (teachers creating learning environments for students) relative to the general methodology (anyone creating learning environments for anyone). So, when the methodology for teachers is presented (Chapter VI), it will be contrasted and compared to this general methodology for anyone.

Methodology

Purpose: To create a learning environment.

Explanation of Purpose: This methodology assumes that anyone with skills in educational development will be able to follow the listed steps to create an environment (instructional materials, management techniques, facilities, equipment, people) for any

defined group of people in which this group of people will learn cognitive, psychomotor, or affective behaviors that are prespecified or determined as part of the process.

Steps	Explanation of Steps
1. Negotiate Contract	The developer must identify the contract decision-makers: those people who will determine the product to be produced, cost of this product, people required for the job, time for completion, and any other items relative to a binding document. These items must be negotiated and a final determination agreed upon.
2. Identify the Decision-Makers	In many cases the decision-makers are somewhat different once the contract has been drawn up. People such as lawyers and accountants have little say in the actual product being developed so long as the terms of the contract are met. However, the new set of decision-makers will probably include people interested in the content, quality of workmanship, meeting of target dates, results from testing the instruction, and the like. These decision-makers must be identified, the kinds of decisions they

will make determined, and their criteria for success elicited. For instance, the contract monitor may consider any product delivered within two weeks of the target date to be "on time," but more than two weeks late requires a penalty and more than two weeks early deserves a reward.

3. Specify Program Purpose — The program purpose must include <u>who</u> will be taught <u>what</u>. This statement is usually a joint enterprise between the developer and the appropriate decision-maker(s). The two most common techniques are: (1) the developer, following discussions with the decision-maker(s) writes up what he thinks the decision-maker(s) feel(s) is the purpose, and then submits this draft of the purpose to the decision-maker(s) for approval or revision; or (2) the developer can insist that the decision-maker(s) specify the purpose with no input from him (the developer) other than to make sure the statement satisfies the technical requirements of how a purpose should be stated. In some instances the teacher and instructional

		mode will be specified at this point. If those items are "givens," they should be specified; but if they are not "givens," it is much better to let the evolving learning environment dictate who the best teacher and what the best instructional mode will be.
4.	Define the Target Population	This is the second of three iterations of target population. At this point it is necessary to specify the population for whom the learning environment is being created in terms of age, sex, and general characteristics. The specifications need to be precise enough that a needs analysis can be conducted.
5.	State Content Goals	This is a further specification of the content from Step 3, just as the previous step (4) was a further specification of to whom this content will be taught. Once the general content goals are agreed upon by the decision-maker(s), the developer is ready to perform a needs analysis.
6.	Perform Needs Analysis	Using as many data sources as possible (including students, decision-makers,

	experts, and practitioners), determine what learners (1) need to know and (2) need to be able to do to accomplish the purpose. State the results of the needs analysis as general behaviors to be learned.
7. Perform Task Analysis	Using the general behaviors from the needs analysis, data already collected, and any new data required, break each behavior into sub-behaviors that must be learned, and then each sub-behavior into further components until an entire hierarchical network is developed to lead the student to satisfaction of the identified need. This process is continued only as long as it appears productive (i.e., one would not specify reading skills for a population that could read, even though reading may be necessary to satisfy the need), resources are exhausted, or a prespecified stopping point is reached.
8. Develop Behavioral Objectives	These objectives are written to match the items on the task analysis at as many levels as possible. They contain the

behavior the student will learn, the conditions under which the behavior will be performed, and the standard for successful performance of the behavior. These objectives become, in essence, the standards of the program. All following steps are aimed at enabling the students to accomplish these objectives and, of equal importance, insuring that all of the objectives, as stated, should remain. Otherwise the instruction or objectives are changed.

9. Develop Criterion-Referenced Test Items

Criterion-referenced test items should be written for all behavioral objectives. As many parallel test items as will be required for the testing desired should be produced. For instance, pretesting and posttesting require at least two items, and more if the student receives remedial instruction and another posttest. Also, if possible, the items should be written by an agent other than the objectives developer. The items should then be administered to a group of "experts" in the area to be taught.

10. Identify Student Characteristics

This is, in effect, the third time the students have been specified (see Steps 3 and 4). At this point a great deal of precision is necessary. Now that the objectives have been written, it is necessary to determine which of these objectives the students already know (you do not need to teach them) as well as measuring attitude and aptitude that may affect learning of the objectives. Criterion-referenced test items already developed can be used here to measure what percentage of the population has already learned an objective. If possible, an agent other than the materials developer should give the test.

11. Select Objectives

The objectives to be taught can now be finalized, since all possible objectives have been explicated (Step 8), and the pertinent objectives from this pool of objectives modified based on student characteristics (Step 10).

12. Sequence Objectives

A strategy for sequencing must be chosen and the objectives sequenced. Usually,

		objectives are sequenced in a linear, hierarchical, or random fashion, or in a combination of the previous three fashions. This is done after the student characteristics step, so that time is not wasted with objectives which have been, or will be, eliminated.
13.	Choose Instructional Materials	The instructional materials should lead students to accomplishment of the behavioral objectives and should be chosen separately for each objective. Points to keep in mind include the selection of alternate materials for each objective, possibilities for individualization, aptitude treatment interaction (A.T.I.), and a management system for handling alternative materials (such as UNIPAC).
14.	Create Instructional Materials	All conditions from above hold true here. But, if no already existing materials can be located to teach the objectives, new materials must be produced.
15.	Choose Mode of Instruction	The decision on mode follows the materials selection. A determination must be made on the most effective mode(s), such

		as: should a movie be shown to the entire class as a group, to small groups, or to individuals in the class in a carrel?
16.	Specify the Learning Environment	This step entails the laying out of all requirements to operate the system, such as personnel (teachers, librarians, administrators), facilities, equipment, budget, rules and regulations, student management, procedures, etc.
17.	Develop Evaluation Design	The evaluation strategy must be chosen and the kinds of decisions that users of the operating system will be making must be identified. For example, should all objectives be retained? Then, all data gathering instruments relative to the decisions must be developed and analyses designed.
18.	Validation of the System	The system must operate and be revised until (1) all components are validated and (2) mechanisms for continual revision are operating so that the system changes as students' needs change.

19.	Transfer the System to the Users	The system should now be operating correctly and be self-renewing. At this point the developer is no longer needed. His job is finished.

C H A P T E R I V

DIFFICULTIES FOR TEACHERS TO APPLY LEARNING SYSTEMS DEVELOPMENT

Presently the learning systems development approach is being used in many educational settings. A sample of these settings was presented in Chapter II in the section on current uses. Most such samplings show a situation where the following circumstances exist: (1) a commitment from the organization to train their people, spend development dollars, and change their rules and policies; (2) the use of a team of outside consultants for training the local people, setting up operational designs and even doing much of the development work; and (3) willingness to commit extra resources to the project, usually in terms of both time and money (see discussion in Chapter I).

All of the literature commercially published for training people to do learning systems development jobs is written for teams who will do the job. Also, the population for whom these materials are written is "instructional designers" or "educational researchers" or "instructional systems developers" (see annotated bibliography of writings in Chapter II).

The well-known and publicized learning systems development projects and the literature, both discussed earlier in Chapter II, are not geared for the classroom teacher. These projects follow an approach similar to the general methodology presented in Chapter III. This general methodology is not designed for teachers. It assumes a group of experts and

requires skills which teachers do not possess. Earlier chapters have discussed or implied some of the problems which are faced by teachers desirous of using learning systems development. This chapter focuses on exactly what these problems are. The first is lack of learning systems development skills. Teachers do not always have equipment useful in learning systems development efforts. Attitude, or mind set, is another missing ingredient. This attitude problem is closely related to skills, since the lack of skills leads directly to the lack of attitude favorable to using learning systems development. The final two points are interwoven. A commitment by the school district is vitally important. Reasons for the importance of this commitment are presented, followed by the last point, which is the reason this commitment seldom exists.

This chapter is, in essence, an explication of problems faced by teachers desirous of using learning systems development. Later chapters, particularly Chapter VI, will present a methodology which will, hopefully, overcome some of the problems indicated in this chapter.

Skills

For teachers to use learning systems techniques, there is a whole series of skills required other than those that have been taught in teacher training institutions. For purposes of illustration the major skills taught to a teacher, at a specified preparation level, at a specified point in time will be contrasted to the skills needed today to use learning systems development skills.

Teachers come in all sizes, ages, and from many different colleges. Averages are apt to be meaningless with this type of data; therefore a theoretical teacher will be the focus here. A secondary teacher, who received his or her training in the mid-1960's, might well have taken the following courses:

(1) Educational Psychology

(2) Reading/Statistics/Media

(3) Foundations

(4) Classroom Observation

(5) Practice Teaching

These courses, plus the required hours in an academic area, satisfied state certification requirements and constituted the typical program in a state such as Connecticut, which was fairly typical of the time period.

The student probably received enough educational psychology to be aware of the field, but nothing of much direct application in the classroom. The next course is described as having been taught in one-third of a semester segments. The statistics segment consisted of learning test formulas that no one ever used; the media segment was a survey of common pieces of media equipment; and the reading segment was usually helpful in pointing out the requirement for insuring that one's students could read the subject matter, as well as suggesting what to do if the students were experiencing difficulties (one of the more useful portions of the program). The foundations course was usually interesting to history and philosophy students, since educators such as Plato,

Comenius, Rousseau, Herbert, and Dewey were apt to be focused upon. However, the course was designed to provide perspective rather than skills to be used in the classroom. The classroom observations and practice teaching experiences varied, but were generally useful in terms of building confidence to actually take over a class and teach.

The teacher described above has now been teaching for five or six years and is probably well on the way to a Master's degree. However, the Master's degree courses are most likely in an academic area, and any education courses are apt to build on the areas mentioned above.

For a teacher to apply learning systems development techniques, the following skills are required:

(1) Perform needs analysis

(2) Perform task analysis

(3) Write behavioral objectives

(4) Write criterion-referenced test items

(5) Determine student characteristics

(6) Select learning materials based on objectives and student characteristics

(7) Develop appropriate learning environments

(8) Design evaluation

(9) Validate the course of instruction

(These skills are more thoroughly described in Chapter VI.)

As is readily apparent, there is little overlap between the secondary teacher trained in the mid-1960's and the skills necessary to apply learning systems techniques. The educational psychology course (Item 1)

did not even include any programmed instruction or behavioral objective writing experience. The statistics instruction (Item 2) was not useful to any sort of criterion-referenced data collection or analysis. Foundations (Item 3) was affective/appreciation type instruction. Classroom observation and practice teaching required the nascent teacher to apply planning skills (see discussion in Chapter II on contrasting the learning systems process and the teaching process), but these skills were intuitively derived or learned from a practicing teacher who had received teacher training from five to thirty-five years previously.

It is quite possible that our teacher may have learned some of the learning systems development skills (such as knowledge of what a behavioral objective is) through attendance at conferences or through reading literature. However, this is different (and less satisfactory) than receiving formal training in those skills and falls far short of bringing the teacher up to a level where he or she can use all of these techniques to develop instruction.

Equipment

For using learning systems development, most teachers have the kinds of equipment that are useful. The lack is more apt to be in quantity and in knowledge of new ways of organizing the equipment.

Teachers usually have tape recorders, slide projectors, filmstrip projectors, transparency machines, movie projectors, and even, in some cases, multi-media carrels. Also useful to the knowledgeable teacher, but by no means necessary for learning systems development work, are

computers and computer terminals, movie cameras, single-concept film units, and similar "individualized" types of media.

When applying the learning systems approach, it is possible to plan and develop instruction with no media. However, this is a severe constraint. A major benefit of learning systems is the chance to individualize instruction to better meet student needs. For this individualization, it is necessary to arrange the media for small groups of students and to plan and organize the classroom so that students can be at different places in the curriculum at the same time. Also, the computer becomes quite useful for record keeping and data processing, as well as being an instructional tool. For example, CAM (Comprehensive Achievement Monitoring), one of the best planned and developed criterion-referenced evaluation systems commonly used in schools today, is extremely efficient when used with a computer.

Attitudes Relative to Instructional Development

There are a variety of reasons for teachers wanting to learn learning systems development techniques. The usual ones are (1) dissatisfaction with the status quo, and (2) curiosity about something new and different. If teachers learn of their own free will, the previous two reasons suffice; a third reason is, of course, by direct order of the school administration.

An attitude change is every bit as important as the new skills required for teachers to successfully apply learning systems techniques. Samples of these attitude changes follow.

Determining course content. The teacher in Connecticut referred to earlier was not really taught any techniques for determining course content. A sort of intuitive process evolved where the teacher was expected to "cover" the content in the text, plus some additional, or enrichment content, based on personal experience. When using learning systems techniques, the teacher must develop a course that is student-centered. Teacher training institutes have been in favor of student-centered instruction for a long time; however, the institutions never taught their students any techniques for basing the course content on student needs rather than text author or instructor inclinations. Use of learning systems requires the teacher to perform a needs analysis of the students to determine course content. This means that the teacher must include or exclude content based on data other than his or her own inclinations and interests.

Stating course content. Most teachers have been told (but not taught) to use some sort of a content outline. Use of the outline varies, from the teacher who has a mental outline of points to be covered to the teacher who develops a detailed outline that becomes the basis for classroom presentations and is passed out to students so they can readily see what will be taught. Learning systems development requires the use of behavioral objectives. These objectives are always more specific than a course outline because they state the student behavior, conditions under which the behavior will be performed, and the standard of success in performing the behavior. Note also that the objectives are stated in terms of the learner rather than the teacher. Therefore

the teacher must be much more precise in stating course content, and this content is stated as the behaviors the student will display upon completion of the instruction, rather than the points to be covered by the teacher.

Developing tests. Traditionally teachers develop tests after they have taught the topic; the test samples the points taught; and the test results separate students into categories of good, fair, and poor, or the students are rank ordered from best to worst. When using learning systems the test items are criterion-referenced, developed prior to instruction, and provide results that are interpreted in a different manner. Criterion-referenced tests provide information on whether or not a student has learned the content, rather than on how one student compares with another student. A drastic change in attitude is required for teachers to develop tests at a different time in the instructional process, to use criterion-referenced test development theory, and to interpret the results differently.

Measuring student characteristics. This is a step that elementary teachers usually perform in subjects such as reading and perhaps mathematics, but it is rarely accomplished at the secondary level and not usually in a criterion-referenced situation. Also, the intent is a bit different than the older concept of placement. This step provides a precise measure of which objectives students already know (using the criterion-referenced test items), and also measures aptitude and attitude. This information is then used as the basis for developing instruction. The instruction teaches the objectives not known, builds

in affective instruction where required based on attitude measurement results, and should not exceed the limitations discovered in terms of aptitude. These kinds of activities are expanded a good deal over the earlier notions of measuring to discover where to place a student in the progression of the course content.

Choosing instructional materials. This used to be almost perfunctory. The textbook was used with a sprinkling of supplementary books, movies, field trips and the like for variety and enrichment. Now the behavioral objectives provide the guidance for choosing instructional materials. Also, student learning characteristics should be taken into account. This means that the materials must lead students to the accomplishment of the behavior stated in the objective. Also, alternate materials are probably required to satisfy students who learn in different ways.

Evaluation and validation. Rather than testing that separates students into groups (A, B, C, D, F, etc.), the results are used to revise the instructional materials until nearly all students can accomplish the objectives. Data is also gathered to update the instruction, make sure the objectives remain relevant, and the like. The whole concept of evaluation is of prime importance in learning systems development and has consequences far beyond the mere assigning of grades.

By now it is possible to see that as well as acquiring a new set of skills a classroom teacher needs to alter attitudes toward developing instruction if the learning systems approach is to be used. In some cases the new attitude requires the unlearning of an old one, such as

in testing. In other cases the new attitude can be an expansion of what the teacher may already be doing, or may wish he or she were doing, such as measuring student characteristics.

Commitment of the School System

The cases where learning systems development techniques (or portions of the approach) have been successful (e.g., Amherst, Massachusetts; South Glens Falls, New York; Wethersfield, Connecticut) all have one common factor. The school district and top school administrators strongly support the project. Some of the reasons that this commitment by the school district is so important are listed below.

Rules. Quite often the old rules are no longer sensible when learning systems development is used. An example is promotion: time is less a criterion of success than the accomplishment of a set of objectives; therefore students may be ready to move from one grade to the next at many varied points in time. Also, all of the attitude changes discussed above apply to the school administration, support personnel, school committee and community as well as to the teachers.

Resources. These include time, money, facilities, and even personnel. More planning time is necessary simply because so much more planning is required to use learning systems development techniques. Facilities that encourage individualization, such as carrels and resource centers, are most helpful. New personnel, such as an overall coordinator and a trainer of teachers (Amherst, Massachusetts) or a local program manager and data processor (recommended by SPPED) are

usually a necessity if the program is to be successful. All of these suggestions require more money.

Consultants. Invariably a series of consultants are necessary to train the teachers and administrators in the new techniques and to help set up procedures to follow. For instance, South Glens Falls, New York, continually receives help from the State Education Department; the district has hired consultants to help set up management procedures for individualized learning (UNIPACS), for writing behavioral objectives, and for performing needs and task analyses, as well as for the overall concepts involved in learning systems. The district has plans to hire still more consultants in the future.

Why This Commitment Is Seldom Available

For a classroom teacher to use learning systems techniques, the support of the school district is most helpful for all of the reasons listed above. However, this support is rarely available.

The most visible reason that few districts are supporting learning systems development activities is money. It costs money to train teachers, to hire new staff, to hire consultants, to reorganize the school operation, to purchase new equipment and hire computer support, and to revise existing facilities. School budgets are being cut more and more often as the mild recession of 1970-72 alters the priorities of taxpayers. The future, which lies with the school children of a community, is distant and felt less than the pressure of widespread unemployment, the need to pay skyrocketing taxes, and the daily requirements of food,

shelter, and recreational expectations.

The attitudes toward education held by the school administration, the school committee and the community are constraints in many cases. Individualization is feared; the systems approach is suspect in terms of dehumanizing education; and in many small communities the attitude is "what was good enough for me (school and school program) is good enough for my kids." An example of this kind of thinking occurred in Barre, Massachusetts, where repeated referendums in the 1950's and 1960's to replace a 1900-model high school with no gymnasium, no cafeteria and no real science facilities were repeatedly defeated.

Another reason for not adopting learning systems development techniques is ignorance. Just as teachers are not trained in these techniques, so administrators are deficient in knowledge in this area. Also, for administrators who do learn about learning systems, the job of explaining and creating interest on the part of the school committee, the teachers, and the community is monumental. This point of knowledge was clearly depicted when a teacher, who was also a parent of children in the Amherst, Massachusetts, public schools went through a course on learning systems development and later commented: "I feel I now know what the Amherst School District is trying to achieve. I am much more tolerant--and even enthusiastic--about the teaching methods in the elementary school, but I feel that they have instituted (the learning systems development program) in a very poor way." By gaining knowledge, this parent changed from having a negative to having a positive feeling about the program. She realized that obvious faults lay with the

implementers of the program (one suspects that the teachers need to receive as much training in learning systems as this parent now has) rather than with the theory of learning systems development.

The individual classroom teacher who wishes to use learning systems development techniques to develop his or her instruction faces many problems. The obvious ones are lack of skills, lack of equipment, and the necessity to develop new attitudes. Also, the support of the school district, although seldom available in a substantive way for a single teacher to do this sort of thing, is of immense value.

CHAPTER V

REQUIRED SKILLS FOR TEACHERS TO APPLY LEARNING SYSTEMS DEVELOPMENT

Teachers must possess certain skills if they wish to use learning systems development techniques to develop their classroom instruction. These required skills are considered here from two viewpoints. First, the minimal skills a teacher must possess to apply learning systems development are listed. Second, teachers who were interested in, or doing developmental work in, instructional systems development were tested relative to the list of learning systems development skills identified. The data provided then becomes, in essence, pretest data for development of the methodology which will be presented in the next chapter.

Required Skills for Teachers

The skills considered absolutely minimum for a classroom teacher to apply learning systems development techniques to developing classroom instruction are listed in the Appendix. These skills were derived by task analyzing the tasks involved in developing a lesson when using learning systems development techniques. The original task analysis was performed by a learning systems developer and modified based on tryouts with classroom teachers. Major skills and their allied subskills are listed in the Appendix; these skills are all listed in behavioral form. The skills represent an early form of the methodology presented in the

next chapter. Also, they are used as a pretest to determine skills possessed by teachers and as a posttest to identify the gain in skills learned by teachers after having learned the methodology (see test data in Chapter VII).

Skills Already Possessed by Teachers Interested in Learning Systems Development (or Performance-Based Curriculum)

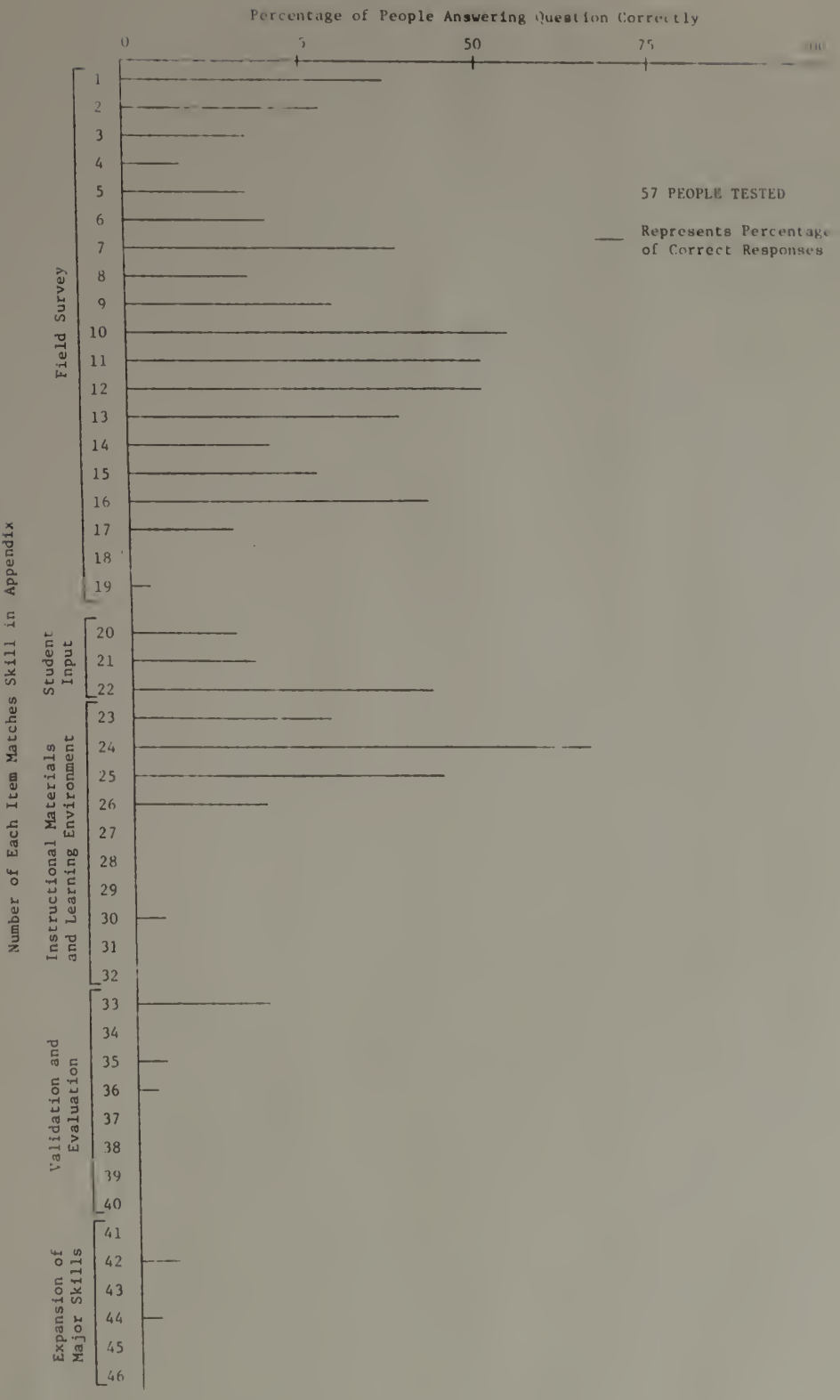
The group tested consisted of teachers and administrators, all interested in learning systems development. Many had already begun using behavioral objectives in their classroom instruction, and others were introducing notions of alternative learning experiences in their classrooms. All were interested in improving their instructional development skills and had done a good deal of studying on their own in addition to trying to implement these ideas (learning systems development/objective-based curriculum).

Criterion-referenced test items were prepared for each skill listed in the Appendix. These test items were then organized into test forms and administered to the group of 57 teachers and administrators identified above. The results of this test administration are indicated in Figure 1.

A final note about those individuals being tested: all were already into the area of learning systems development, or portions of learning systems development such as behavioral objectives. Therefore the statistics that follow should not be considered generalizable. Rather, they are the measures of skills possessed by interested and

FIGURE 1

Learning Systems Development Skills (Pretest)



informed teachers relative to learning systems development.

Analysis of test results. A careful analysis of responses shows that some of the teachers know some of the skills necessary for applying learning systems development, but that none of them possess all the skills required. Also, remember that this listing (the Appendix) contains minimal, not maximal, skills required.

The field survey ("field survey" was a formerly-used term that included needs analysis, task analysis, behavioral objectives, and criterion-referenced test items) skills indicate the primary weakness of the self-study approach taken by the teachers surveyed. More than 50% can identify definition and situational use (Items 10, 11, 12), but the application of skills such as writing behavioral objectives and test items (Items 14, 15) is not possible for more than 25% of the teachers. As can be seen, there is quite a drop in skill level between theory (over 50%) and application (under 25%). Another problem readily apparent is the lack of knowledge of needs analysis and task analysis (Items 1-6); only 10-20% of the teachers possess these skills. Lack of comprehensive knowledge (such as not knowing needs analysis) is a major problem when applying learning systems development, since all aspects are required due to the interdependency of components.

The one other area in which a large number of teachers (over 50%) possess learning systems development skills is the area of instructional materials (Items 24, 25). This knowledge is again indicative of self-study on the part of the teachers tested.

This pretest of learning systems development skills clearly shows

that teachers are not taught these skills in college, inservice training programs, or professional journals. Some isolated skills, such as using behavioral objectives, are being learned; but these skills are of little value in isolation. There is an entire developmental process, called learning systems development in this study, that must be utilized for maximum benefits to the students. Utilizing isolated portions of the process such as behavioral objectives, without using the entire process, may even lead to harm rather than benefit (Hamreus, 1970).

The teachers tested were all interested in learning systems development but had not been able to learn the skills necessary to use the process. The methodology presented in the next chapter is designed to satisfy this problem.

CHAPTER VI

METHODOLOGY OF LEARNING SYSTEMS DEVELOPMENT SKILLS TO BE USED BY TEACHERS

This chapter presents the major product of this study: a methodology to be used by teachers who wish to use learning systems development skills in their instruction. The chapter is divided into three major sections. First, the term "methodology" is explained. The term has been used rather freely and deserves to be explained in enough detail to fully clarify its meaning. Second, the methodology for teachers is presented. Third, the methodology in this chapter, which is designed for teachers to use, is compared with the generalized methodology in Chapter III, which can be used by anyone.

Explanation of the Term "Methodology"

A methodology "is a series of operational steps that accomplish a specific, definable purpose." The methodology includes a "well-defined route that accomplishes the purpose" and "attempts to supply as much as possible to the user as far as procedures, sequence, etc. are concerned." "These are three things necessary to produce the best possible methodology for a definable purpose: (1) the determination of the purpose; (2) the development of the steps that make up the methodology; (3) the testing of the methodology to see that it indeed accomplishes the purpose." The above was extracted from "Meta-Methodology: An Overview of What It Is and Its Development" (Thomann, AERA, 1973).

A form of methodology is used quite often in everyday life by most people, although most do not think of what they are doing in terms of the notion "methodology." For instance, giving someone directions to one's house is a form of methodology, with the purpose being to arrive at the house. A series of steps (or directions) is stated. The series of directions is usually revised, if anyone has trouble, until it is possible to direct people to one's house and be quite sure that they will arrive.

The methodology in this chapter contains a purpose and a series of operational steps. The purpose is not simply to teach teachers to use the learning systems development process, because this is in essence a way to accomplish a goal. It is an interim goal only. The real purpose of the methodology is to provide a process for teachers to create a relevant and effective learning environment for students. Learning systems development will be built into the process as the vehicle to use in accomplishing this purpose.

The validation of the methodology (Thomann's Step 3) will be presented in the next chapter (Chapter VII). This is an ongoing testing process and is not yet complete.

Methodology for Teachers

Purpose: To provide a process for teachers to create a relevant and effective learning environment for students.

Explanation of Purpose: This methodology assumes that any teacher with skills in educational development will be able to follow the listed

steps to create an environment (instructional materials, management techniques, facilities, equipment, people) for a defined group of students, where these students will learn cognitive, psychomotor or affective behaviors that are prespecified or determined as part of the process. This environment should be relevant (i.e., meet the needs of the students) and effective (i.e., prove that what is purported to be taught is, in fact, taught). The teacher is the assumed developer in this methodology, although the notion of "teacher" can be broadened to include a small or large group of people, including students, if they have decision-making power. Students are those for whom the instruction (learning environment) is being developed, although it is possible for the teacher to also be a student part of the time.

Steps	Explanation of Steps
1. State Purpose of Course	The course purpose must include <u>who</u> will be taught <u>what</u>. In many traditional situations the purpose is stated, or implied, in curriculum guidelines. An example of the above might be: to teach introductory algebra to ninth grade students. Where the purpose is not a "given" the teacher, either alone or with students, decides on the course purpose. This is more apt to be the case in new, experimental, or non-core-curriculum courses.

2.	Define the Target Population	Definition of the target population requires specification of the students in the course in enough detail for a needs analysis to be performed. The age, sex, and general characteristics should be specified. In essence, the student must be described as an anonymous entity, rather than as a specific person by name.
3.	Determine Data Sources for the Needs Analysis	Two activities are required in this step. First, as exhaustive a list of data sources as possible should be generated. This list should include other teachers, students, experts, parents and community, employers, texts and magazines, curriculum guides, and personal opinion. The second aspect is to determine the extent to which these sources can reasonably be tapped. It is necessary to prioritize and gather data based on time and resources.
4.	Specify Questions to be Asked	Once the data sources have been identified, it is necessary to determine what questions to ask each of the data sources; i.e., to determine what information one expects to glean from each data source.

5.	Determine Instruments to Use for Needs Analysis	Select appropriate instrument or approach to gather data from each source identified above. The choices usually consist of observation, interview, questionnaire or document review. The instrument must then be prepared.
6.	Collect Needs Analysis Data	This collection of data consists primarily of putting into effect two previous steps. The instruments from Step 5 are used to collect data from the sources identified in Step 3.
7.	Organize Needs Analysis Data into Goal Statements (Topical Areas)	The data collected in the needs analysis must be organized. This includes grouping by major topical area, stating student needs by major area as goal statements, and holding all other data collected for use in the task analysis.
8.	Outside Review of Needs Analysis	If no outside review has been accomplished earlier during the needs analysis, it should be done at this time. The review should include critique by a specialist in learning systems development to check the techniques used and by a specialist in the content area to check on the major needs identified from

		a content point of view. Other reviewers may also be required at this point, such as administration, students, community, psychologist, and the like.
9.	Finalize List of Goal Statements	The earlier list of goal statements can now be modified following outside review.
10.	Perform Task Analysis	Using the general behaviors from the needs analysis, data already collected, and any new data required, break each behavior into sub-behaviors that must be learned; then break each sub-behavior into further components until an entire hierarchical network is developed to lead the student to satisfaction of the identified need. This process is continued only as long as it appears productive (i.e., one would not specify reading skills for a population that could read, even though reading may be necessary to satisfy the need), resources are exhausted, or a prespecified stopping point is reached.
11.	Outside Review of Task Analysis	The outside review should be performed primarily by the learning systems developer and the content specialist, to make sure there are no major errors.

12. Develop Behavioral Objectives

There are two major sources of objectives. First, already prepared lists are available such as IOX in California, SPPED in New York, and the CO-OP at the University of Massachusetts. These lists will never supply all the objectives that teachers require, based on the needs analysis, but they may provide a good start. Second, teachers can write the objectives. This can be done on an individual basis or in teams with the job shared. These objectives are written to match the items on the task analysis at as many levels as possible. They contain the behavior the student will learn, the conditions under which the behavior will be performed, and the standard for success in performing the behavior. These objectives become, in essence, the standards of the program. All following steps are aimed at enabling the students to accomplish the objectives and, of equal importance, at insuring that all of the objectives, as stated, should remain. Otherwise the instruction or the objectives are changed.

13. Sequence Behavioral Objectives

A strategy for sequencing must be chosen and the objectives sequenced. Usually objectives are sequenced in a linear, hierarchical, or random fashion, or in a combination of the three

		fashions. The task analysis provides broad sequencing guidelines, but this step allows for more finite decisions on how students will proceed through the objectives.
14.	Code the Behavioral Objectives	Choose a numerical coding system to apply to objectives to make possible easy access, computer or paper banking, quick reference and follow-up coding of items and instructional materials. The coding system should allow for two or three levels of objectives with two digits assigned to each level.
15.	Outline Review of Behavioral Objectives	The review should be performed by the learning systems development specialist and the content specialist.
16.	Develop Criterion-Referenced Test Items	Criterion-referenced test items should be written (or selected from an existing test item bank) for all objectives. As many parallel test items as will be required for the testing desired should be produced. For instance, pretesting and posttesting require at least two items--more if the student receives remedial instruction and another pretest. It is desirable to have the test items produced by a team of teachers wherever possible.

17.	Code the Criterion-Referenced Test Items	The test items should be given an identification code which relates to their corresponding behavioral objectives. This can be done by adding two digits to the right-hand end of the objective number (i.e., creating six- or eight-digit item numbers).
18.	Outside Review of Criterion-Referenced Test Items	The review should be accomplished by the learning systems development specialist and the content specialist, as well as any test and measurement specialists desired.
19.	Construct Instruments to Measure Student Characteristics	The step consists of measuring, with as much precision as possible, what the students already possess relative to the desired outcomes of the course. The way to measure this knowledge is to use the criterion-referenced test items to measure which course objectives the students have already mastered. The specific students who will attend the course should be tested. Also, it is desirable to measure aptitudes and attitudes of these students that may affect learning of the objectives, since some attitude or aptitude instruction may need to be added to the course as a prerequisite for teaching course objectives. Commercially

		prepared tests, teacher-made tests, or subjective judgment are all used to measure the attitudes and aptitudes.
20.	Measure Student Characteristics	Once the measures have been identified and procured (prepared, developed), the teacher should measure the student input characteristics.
21.	Outside Review of Student Characteristics	The review of student characteristics should be performed by the learning systems development specialist, the content specialist, and whatever test and measurement specialists are required.
22.	Select Final Set of Objectives	The final set of objectives can be specified following the modification from student characteristics measurement. This set of objectives represents the objectives of the course to be taught by the teacher.
23.	Choose Mode of Instruction	The decision on mode follows the materials selection. A determination must be made on the most effective mode(s), such as: should a movie be shown to the entire class as a group, to small groups, or to individuals in the class in a carrel?

24.	Choose Instructional Materials	The instructional materials should lead students to accomplishment of the behavioral objectives and should be chosen separately for each objective. Points to keep in mind include the selection of alternate materials for each objective, possibilities for individualization, aptitude treatment interaction (A.T.I.), and a management system for handling alternative materials (such as UNIPACS).
25.	Create Instructional Materials	All conditions from Step 24 hold true; but if no already existing materials can be located to teach the objectives, new materials must be produced. The production can be accomplished by the teacher, the students, or both.
26.	Code Instructional Materials	The materials should be keyed to the behavioral objectives they teach. One method is to use the four-digit number for the objective with two digits added to the right-hand end of the objective number (i.e., six digits) to identify instructional materials.
27.	Specify Learning Environment	This requires the laying out of all requirements to operate the learning system, such as: personnel (teachers, aides, specialists), facilities, equipment, rules and regulations,

		student management procedures, etc.
28.	Outside Review of Instructional Materials and Learning Environment	The outside review should be performed by the learning systems developer; the content specialist; and students, administrators, and specialists as required.
29.	Identify Decisions to be Made	Decision-making is part of the evaluation strategy. It is necessary to identify all decisions to be made about the instruction. These include obvious decisions such as: "did the instruction teach," and "what does the student need to review"; as well as decisions such as "which objectives should be eliminated or retained," "what are the changing needs of students," and "are the instructional materials enjoyable or challenging?"
30.	Choose Methods of Data Gathering for Decisions	The data gathering step is similar to Step 5 (Determine Instruments to Use for Needs Analysis). Once the decisions are identified it is necessary to identify/choose/develop methods of gathering data to make the decisions. These methods can be criterion-referenced tests, questionnaires, interviews,

		observation, or other data gathering techniques.
31.	Gather Evaluation Data	Once the decisions and methods of gathering data have been identified, the data can be gathered at the appropriate time during the course of instruction.
32.	Revise System Components as Necessary	Use the data gathered in the previous step to make alterations and adjustments in the system. This is the feedback step, and should never be completed. Part of the power of this approach is the dynamic, rather than static, aspect of the process. Change should be built in as part of the process because students change and their needs change; the system should be responsive to these changes.
33.	Outside Review of Evaluation, Validation, and Revision	The review should be performed by the learning systems development specialist, the content specialist, and evaluation specialists as required.

Comparison of Specific and General Methodologies

A general methodology with the purpose "create a learning environment" was presented in Chapter III. This chapter (Chapter VI) presents a specific case of the general methodology, in which teachers create a relevant and effective learning environment for students. In essence, the methodology just presented is the major product of this study. Following is a comparison between the two methodologies to show the changes made in the specific methodology relative to the general methodology. First the steps of each methodology are listed side by side, and then the differences are discussed. The numbers list sequence only, as shown in the explication of the two methodologies (general in Chapter III and specific in this chapter). Comparative steps appear next to each other.

Steps in the Methodologies

General	Specific
1. Negotiate Contract	
2. Identify Decision-Makers	
3. Specify Program Purpose	1. State Purpose of Course
4. Define the Target Population	2. Define the Target Population
5. State Content Goals	
6. Perform Needs Analysis	3. Determine Data Sources for the Needs Analysis
	4. Specify Questions to be Asked
	5. Determine Instruments to Use for Needs Analysis

	6. Collect Needs Analysis Data
	7. Organize Needs Analysis Data
	8. Outside Review of Needs Analysis
	9. Final List of Goal Statements
7. Perform Task Analysis	10. Perform Task Analysis
	11. Outside Review of Task Analysis
8. Develop Behavioral Objectives	12. Develop Behavioral Objectives
	13. Sequence Behavioral Objectives
	14. Code the Behavioral Objectives
	15. Outside Review of Behavioral Objectives
9. Develop Criterion-Referenced Test Items	16. Develop Criterion-Referenced Test Items
	17. Code Criterion-Referenced Test Items
	18. Outside Review of Criterion-Referenced Test Items
10. Identify Student Characteristics	19. Choose Instruments to Measure Student Characteristics
	20. Measure Student Characteristics

11. Select Objectives
12. Sequence Objectives
13. Choose Instructional Materials
14. Create Instructional Materials
15. Choose Mode of Instruction
16. Specify the Learning Environment
17. Develop Evaluation Design
18. Validation of the System
19. Transfer the System to the Users
21. Outside Review of Student Characteristics
22. Select Final Set of Objectives
23. Choose Mode of Instruction
24. Choose Instructional Materials
25. Create Instructional Materials
26. Code Instructional Materials
27. Specify the Learning Environment
28. Outside Review of Instructional Materials and Learning Environment
29. Identify Decisions to be Made
30. Choose Methods of Data Gathering for Decisions
31. Gather Evaluation Data
32. Revise System Components as Necessary
33. Outside Review of Evaluation, Validation, and Revision

Comparison of steps. The major differences in the methodologies fall into three categories. First, there are a few steps in the general methodology not contained in the specific. Second, the specific methodology has more detail for some steps than the general. Third, there is a reordering of steps in the specific methodology in two instances.

The general methodology contains three steps that do not exist in the specific methodology. These steps occur at the beginning and at the end. "Negotiate a contract" and "identify decision-makers" (Steps 1 and 2) are not required in the specific methodology because presumably the teacher already possesses a contract to teach. Also, the teacher is the prime decision-maker; although, at the teacher's option, this decision-making can be shared with or turned over to the students. The final step of transferring the system to the users (Step 19) is not required in the specific methodology either, since the teacher is the user.

The specific methodology has more detail in some steps. The preceding lists of steps clearly show this added detail; since three steps are omitted from the specific methodology, the specific methodology has 33 steps corresponding to 19 steps in the general methodology. The added detail is visually portrayed by gaps. This detail is necessary because teachers are not full-time curriculum developers. It is therefore easier for them to follow smaller and more specific steps rather than the larger steps of the general methodology. For instance, instead of telling a teacher to "perform a needs analysis" (Step 6 of the general), it is far easier for the teacher to (1) determine data sources for the needs analysis, (2) determine instruments to use, (3) collect data, and (4)

organize the data (Steps 3-8 of the specific). This specificity is shown for developing objectives, identifying student characteristics, and evaluation. Another aspect of the specificity is the built-in outside review following each major phase of development by the teacher. Outside review is critical for any organization developing curriculum. It is even more important where the teacher may be the only decision-maker and may not be a learning systems development specialist or, in some cases, a content specialist. Also, this paper is focusing on the specific methodology rather than the general. It is quite possible that the general methodology could eventually contain even more steps so that many different contingencies would be covered; and that specific methodologies, such as the one for teachers, would utilize only some of the steps of the general methodology. However, at this point the specific methodology is the methodology being focused upon and, consequently, contains the most steps.

Some steps are reordered in the specific methodology. This reordering occurs in two places. First, in the general methodology sequencing objectives (Step 12) follows identification of student characteristics (Step 10). This order is used for purposes of efficiency. A more natural location for sequencing objectives is following their writing and prior to measuring student characteristics. Therefore, sequencing objectives (Step 13) follows writing objectives (Step 12) and precedes measuring student characteristics (Step 19) in the specific methodology. The second reordering occurs in choice of instructional mode. In the general methodology choosing the mode (Step 15) follows creation of

instructional materials (Step 15), since this seems to be a logical order and since the creation of instructional materials is apt to be a much larger job than choosing the mode of instruction. However, the order is reversed in the specific methodology because teachers feel very uncomfortable discussing what materials they will use prior to determining the mode of instruction. This is probably due to the fact that they are more personally (ego) involved in the mode of instruction and are able to conceptualize from what they do to other items more easily than the reverse.

CHAPTER VII

TESTING OF THE METHODOLOGY FOR TEACHERS

This chapter will be concerned with the third step of developing the best possible methodology (Thomann, AERA, 1973) as stated in the preceding chapter: the testing of the methodology. The theoretical base of the testing (field testing) process will be presented. Then the assumptions and compromises built into the testing process will be discussed. Finally, the test data obtained will be presented.

Field Testing

Field testing is a process of trying out the product being produced to ascertain its effectiveness. In the case of the methodology being developed, field testing means trying out the methodology on teachers. The data of interest is whether the purpose of the methodology "for teachers to create a relevant and effective learning environments for students" is accomplished.

There are some notions involved in field testing that are important. One is who will participate in the field test. The target population (those tested) must be carefully specified, and the testing should only be done in relation to those within the target population under normal circumstances. Exceptions do exist, such as small number of persons available within the target population, lack of time for multiple tests on persons within the target population, and lack of funds to test those within the target population. Any constraints must

be carefully examined for their implications to the test results, and the tester must modify his interpretation of test results based on the existing constraints.

Another important notion relates to the testing procedures involved. Tests are begun with portions of the product (in this case the methodology) in tightly controlled situations and are expanded until the entire product (methodology) is tested in "field" conditions; hence the term "field test." This means, in a practical sense, that the developer of the product tests out his product bit by bit as it is developed, with just a few people at a time. Then, when the entire product has been developed, he tries it out with the target population. This test product will have far fewer faults, however, due to the earlier tests--which will have eliminated many of the most obvious problems. The final, or field conditions, test usually does not include the developer at all, unless he will always be available when the product is used. This final test is really a test of the product plus all associated directions and supporting equipment, since it must stand completely on its own.

The use of data in field testing is important. In essence, criteria have been prespecified and the product is tested to see if the criteria are met. The implication is that where criteria are not met, either the product or the criteria need to be revised. In field testing the assumption is that the former should be revised rather than the latter (although in some cases, legitimately or otherwise, the criteria are changed). Therefore, the test results become part of the developmental process, since it is assumed that not all criteria will be met

and that revision will be necessary. In fact, it is desirable not to have all criteria met, since this allows the developer to use the target population (through test results) to determine where and how much to revise.

Finally, the above notions include another implication for the product. To be field tested, the product must have a purpose that includes supporting criteria. The methodology has a measurable purpose. Supporting criteria, such as the pretest skills listed in the Appendix, also exist. Both are important for field testing. Unless a purpose exists, there is no way of knowing exactly what the product should accomplish. Unless supporting criteria exist, there is no way of knowing what the product components are. If one does not know what the product components are, it is exceedingly difficult to revise weak portions of the product, since it is nearly impossible to identify what the weak portions are.

Testing Process for Methodology Being Developed

The purpose of the methodology being developed (and presented in the previous chapter) is for teachers to develop relevant and effective learning environments for students. Ideally, then, the testing process should measure whether or not the purpose, as stated, is being accomplished. However, the methodology is still in the first steps of development, and constraints (mostly time constraints) precluded large-scale testing of teachers' ability to apply the methodology in their classrooms. Therefore, the early stages of testing and revision have been

based on more easily obtained data which represent, in effect, compromises with the desired data of classroom implementation.

The field testing is being conducted in three stages. The final test (field test) is for the methodology to be implemented in a classroom situation where teachers are able to develop relevant and effective learning environments for students (the purpose of the methodology). The stage of testing prior to classroom implementation consists of having teachers develop instruction that follows all steps of the methodology except implementation. The earliest stage of testing consists of measuring whether or not teachers possess the skills to use the methodology.

To date, testing has proceeded from the skill level to instructional development but not to implementation. Approximately four test and revision cycles have been accomplished. Results so far have been extremely high. In fact, it is possible to say at this point that the methodology is completely successful in terms of the skill level and the instructional development level. The testing for each level is more fully described below.

Description of steps in testing. The first step back, or compromise, is to have teachers develop instruction based on the methodology. The assumption is that development of a lesson insures the teacher's ability to follow all steps minus the actual implementation. These data have been collected in the form of lessons, developed by teachers, that must include needs analysis, task analysis, behavioral objectives, criterion-referenced test items, measures of student characteristics,

instructional materials keyed to the behavioral objectives, provisions for an appropriate learning environment, evaluation and validation strategies, and feedback loops.

The next step back, or further compromise, is to measure teachers' knowledge of all skills necessary to apply the methodology. This requires using the list of skills presented in the Appendix in a posttest fashion. These data have been collected.

Data from the two intermediate steps mentioned above become quite important in the revision, because it is possible to trace the ability of teachers from knowledge to development to implementation. Also, if a major problem occurs it can be readily identified as to which stage in the process is causing the difficulty.

Even though most data collected, and revisions to the methodology, were based on the interim steps mentioned above, a few teachers were followed all the way through to implementation. Based on the few cases of implementation it is possible to tentatively assume (1) that the methodology will accomplish its purpose and (2) that implementation will require a good deal of effort to completely work out.

Skill level test. The skill level test was conducted using the same skills as identified as pretest skills in Chapter V. The skills are listed in the Appendix. In essence, these data consist of posttest results when compared to the pretest results in Chapter V.

The persons tested consisted of 34 public school teachers and administrators. All were highly motivated and desirous of learning to use the methodology to develop (or supervise the development of)

instruction in their own classrooms and schools.

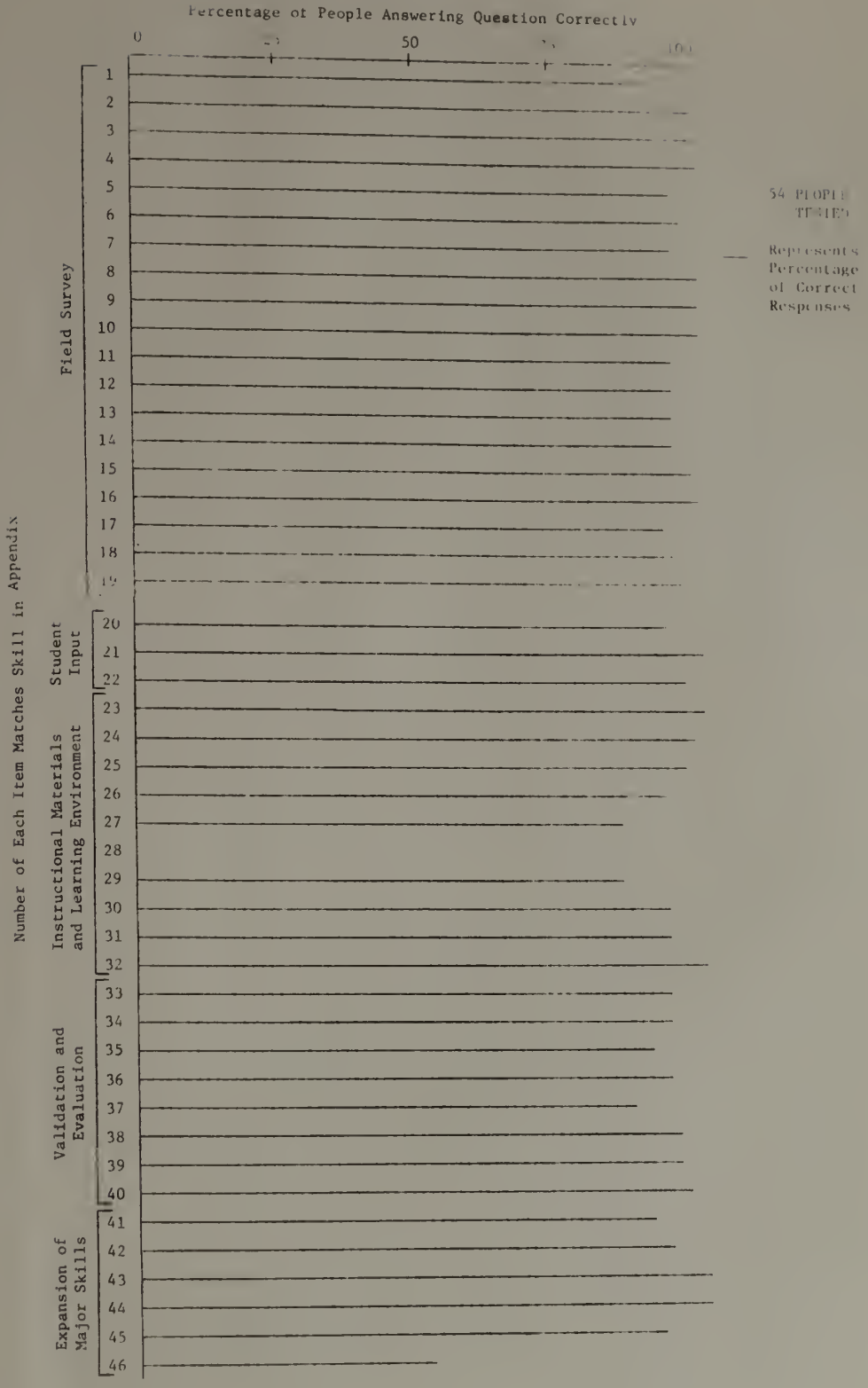
The test results (see Figure 2) indicate a very high level of proficiency in the area of field survey (needs analysis, task analysis, behavioral objectives, criterion-referenced test items) and the area of student input (characteristics). The only real weaknesses were in programmed instruction and internal and external validation. With the exceptions just noted, it is fairly safe to conclude that teachers can learn the skills necessary to use the methodology.

Instructional development level test. The next step to test is whether or not teachers can apply the skills to develop instruction as required by the methodology. The instruction was presented in the form of a package that included either the following steps or plans on how to accomplish the following steps: course purpose, needs analysis, task analysis, behavioral objectives, criterion-referenced test items, student characteristics, instructional materials and learning environment, evaluation, validation, and feedback. Combining results from five groups, 44 of 48 teachers were able to successfully develop instruction containing the above components (and following the methodology). Of the four who were unsuccessful, three, with guidance, were able to revise their instruction until the instruction conformed to the methodology.

Implementation level test. Not many teachers measured during the first two steps have yet had an opportunity to attempt implementation of the instruction. Approximately 20% have tried and all have been successful. However, difficulties have been encountered. First, teachers find the process time consuming. They either use the methodology in

FIGURE 2

Learning Systems Development Skills (Posttest)



successive waves of specificity, or they apply it only to small portions of their courses. Second, they are concerned about the variance between school rules and methodological requirements. Third, teachers require continuing support from someone, either in the school or in an agency respected by the school (such as a university or SPOKE), who is able to critique what is being done and provide suggestions and encouragement.

On the positive side, all teachers have been extremely encouraged by the use of the methodology. Students learn more information more quickly. Both teacher and students have a much clearer idea of what is happening in the classroom. Motivation seems higher. In addition, the schools (i.e., other teachers, administrators) are watching the teachers with a great deal of interest which is gradually shifting from negative-neutral to neutral-positive.

The conclusions, at this point, are: (1) teachers can learn the required knowledges; (2) teachers can use the methodology to develop instruction; and (3) it appears that teachers can implement instruction based on the methodology, but a good deal more work is required in this area.

CHAPTER VIII

METHODS OF APPLYING THE METHODOLOGY

A major problem for teachers in applying this methodology is the time factor, i.e., the availability of time to devote to learning systems development work. Within the conventional school constraints, it is simply not possible to apply the entire process to an entire course of instruction all at once. This being the case, there are basically two alternate compromise routes available (with a third, teams of teachers, available with some reorganization). One compromise route consists of applying the learning systems methodology, in considerable detail, to a specified subset of the course. This would allow the teacher to systemize the course unit by unit. An alternate approach is to begin systemizing on the broadest level possible, and to gradually refine and add further sophistication and specification for each subsequent application. There are strengths and weaknesses in both approaches.

Unit-by-Unit

Unit-by-unit is the typical course organizational structure. Usually the teacher will design a course with "X" number of major areas (units) of study. This number is apt to range from six or seven to twelve or thirteen. The units usually require "Y" amount of time to complete; the time frame is typically from three to five weeks. Examples of units in an American history course of a traditional sort would include "Colonization," "Disputes with England," "The American

Revolution," etc. The unit approach is organizationally familiar to teachers and is something with which they feel comfortable.

When applying the learning systems development methodology to a course one unit at a time, it is possible to go into a great deal of detail and really see the technology work. Developing the methodology unit by unit usually means that a less comprehensive purpose is stated. In addition, the needs analysis is less apt to be related to larger, more important student goals. However, a detailed task analysis can be accomplished at the unit level; behavioral objectives for all levels of the task analysis can then be written, as well as the required number of criterion-referenced test items for an adequate pretest, posttest, and retention or review test. When preparing a unit, it is usually possible to develop some measure of attitudes and aptitudes relative to the content of the unit, as well as providing some alternative learning materials and a carefully engineered learning environment. Also, the evaluation, revision and recycling can be developed in a complex and useful manner.

There are many benefits to the unit-by-unit approach. Both teacher and students reap obvious benefits from the learning systems development process, as the relevancy of the subject matter, individualization, effective and efficient instructional materials, and emphasis on students as important aspects of the learning process are readily visible. This usually creates a great deal of enthusiasm among the students, because they see the usefulness of what they are learning, they are challenged rather than bored by the presentations, and they are successful.

Teachers' enthusiasm is usually based on student enthusiasm, which is apt to be contagious, and on student success, both of which are quite rewarding; it is also based on the personal satisfaction of successfully implementing a new, and rather sophisticated, approach to their preparation of instruction.

A benefit of applying learning systems development unit by unit is the fact that teachers are able to hone their skills as they proceed. Since the process is new to them there will be some trial and error, adjustment of thinking and planning, differing means of implementation and evaluation, and the like. The unit-by-unit approach allows teachers to go through the same developmental process for each unit. In essence, they have a chance to practice the same learning systems development skills over and over for however many units are in their course.

There are drawbacks to the unit-by-unit approach. The teacher does not progress from the course purpose to ever more specific items which will eventually lead students to this purpose. Since the development is linear rather than pyramidal or hierarchical, a less effective needs analysis results. What is meant here by "linear development" is that teachers are dealing with units, not the course as a whole. Therefore development is linear from Unit 1 to Unit 2 all the way to Unit "n." Because of this linear development, overall course planning such as needs and task analysis are sacrificed for planning at the unit level. The course is much more likely to teach the same content as always, albeit in a more efficient manner, because the important overall perspective of purpose to needs analysis, task analysis, behavioral objectives,

etc., is lost. The other major drawback relates to that portion of the course which has not been revised. Both teacher and students are apt to become frustrated and easily dissatisfied with this "remainder" of the course. The students do not understand why parts of the course are appropriate, easy to learn, and provide feelings of success, while other parts of the course are more obscure. Teachers echo the same feelings, which can turn into feelings of inadequacy if the ground rules are not carefully worked out with students so that they become part of the course development, rather than someone being experimented with.

An alternative to developing instruction unit by unit, from the first to the last unit, is to reverse the process and develop units from last to first. This process overcomes some of the frustrations encountered when the better-planned units are at the beginning of the course. However, unless the teacher is very careful to identify overall course goals and to have all instructional development lead toward student accomplishment of the goals (end goals, not interim ones), the teacher loses the opportunity to adjust content to goals during course development. This adjustment is more likely to occur when the teacher begins with the first unit, because development skills are improved by the time the teacher reaches later units; also, the teacher usually becomes increasingly sensitive to student needs.

Progressive Layers

The progressive layers approach is much more consistent with learning systems development philosophy. "Progressive layers" refers

to development beginning with the end goal of the course and then, in hierarchical fashion, proceeding through each prior step in the learning systems development approach which is necessary to accomplish the course goals. Therefore each step in the learning systems development approach is considered another layer; hence the term "progressive layers."

This progressive layers approach requires application of the methodology to the whole course at once, but in much less detail than in the unit-by-unit plan. This usually means stating the purpose of the entire course and performing a rather thorough needs analysis. The task analysis is only taken to perhaps one or two levels of specificity. Terminal objectives, with corresponding criterion-referenced test items, are written for the few items of the task analysis. The measurement of student characteristics is difficult due to the lack of detailed objectives, and it is apt to take the form of an informal interview if attempted at all. Instructional materials are generally grouped around the appropriate terminal objectives. Evaluation is quite imprecise, since only terminal objectives are measured, and decisions must be made on less than detailed data. This process is then repeated again and again until the task analysis is completed in sufficient detail, objectives and test items have been written for all items in the task analysis, student characteristics can be measured, alternative instructional materials (with supporting learning environment) exist, and a properly detailed evaluation is accomplished.

There are benefits derived from this approach. The unevenness of development existing in the unit-by-unit approach does not exist.

Students feel that they are very much part of a developmental activity, since there is usually plenty of opportunity for them to participate. Participation usually occurs in determining the purpose of the course. Students may be consulted; or they may help perform needs and task analyses, set goals and choose or develop instruction. Actually, students turn out to be a valuable resource when developing a course because of the added manpower. Also, the relevancy of the content is apt to be quite evident to students due to the thorough needs analysis based on the course purpose. The teacher has the opportunity to work on the weak aspects of the course first. Any terminal objectives on which many students have difficulty automatically turn into the next part of the course to work out in more detail. In this way, weak portions of the course are automatically improved first, and evaluation data are used to make decisions on course revision.

There are drawbacks with this approach. Even though the quality of the course is more uniform, the uniformity tends to lean toward the ragged rather than the smooth. This raggedness occurs because most of the developmental work for the first and even the second run-through is in the area of course objectives rather than development of instructional materials, since so little work has been done in developing instructional materials which can be revised until validated. This progressive layers approach lays a solid foundation for the course in terms of what will be taught (planning), but it is not as dazzling as the unit-by-unit approach in terms of fancy alternative instructional materials. Also, the teacher and students do not experience the

powerful benefits of the technology applied in anything approaching what is possible, until many (perhaps three or four) iterations of the course have been completed.

Conclusion

The best of all possible worlds, of course, is for teachers to be able to apply the methodology in great detail all at once. Time constraints usually prohibit such an application. There are two alternative compromise routes available to apply the methodology: one is to proceed unit by unit, and the other is to proceed layer by layer. Benefits and drawbacks exist for both procedures, and a teacher must make some choices based on his own preference, subject, students, and learning situation.

There are, of course, ways and means of combining the two approaches. If teachers can be organized in some fashion so that each works on a single portion of a course taught by all, then development proceeds much more rapidly. For instance, if teachers in a department at the secondary level, or teachers in an open education setting, each take responsibility for curriculum development in one portion of a course taught by all, much time can be saved.

CHAPTER IX

CONCLUSION

This study is reporting an ongoing effort to enable classroom teachers to use learning systems development techniques in developing instruction for classroom use (classroom is defined in the broad sense of where the instruction occurs, rather than the narrow sense of a room with 30 students, one teacher, two doors and four windows). Therefore, this report on progress must sum up what has occurred to date and draw conclusions; but of even more importance, it must look to the future. The three main viewpoints reflected here in the conclusion are: (1) a reiteration of why the study was undertaken; (2) the success of the study to date; and (3) the questions to be pursued next.

Purpose of Study

Learning systems development, as an approach to developing instruction, has proved most beneficial where used. These uses include military, industrial, and public school settings. Where used properly (sufficient resources, trained personnel, and administrative support) the gains have been significant in terms of time saved, money saved, and improved student attitude (see Chapter III). However, few attempts have been made by classroom teachers to utilize these learning systems techniques in their development of instruction (see Chapter I). To date, most efforts to institute learning systems development in public

schools have required outside resources, consultants, and a major commitment from the school administration. These and other factors (see Chapter V) have, in the past, made it prohibitive for a classroom teacher to use learning systems development techniques based on his or her personal volition.

The purpose of this study is to produce an approach that can successfully be utilized by classroom teachers to use learning systems development techniques in developing their classroom instruction. This approach took the form of a "methodology" (see Chapter VI). The methodology has a stated purpose to "provide a process for teachers to create a relevant and effective learning environment for students," and a series of steps to follow in order to accomplish the purpose. If these steps are followed the purpose will be accomplished, and teachers will be able to use learning systems development techniques to create learning environments for their students. An item to mention is that learning systems development is a process. Therefore the purpose of the methodology must be stated as a useful end goal, i.e., "create relevant and effective learning environments for students"; then learning systems development can be utilized as the process to accomplish the stated goal (or purpose).

Was the Purpose Accomplished?

On an interim basis, the answer to the question "Was the purpose accomplished?" is a definite "YES." Teachers are definitely able to use learning systems development techniques to create relevant and

effective learning environments for their students. This was shown in the test results in Chapter VII.

There are various items to consider, relative to accomplishing the purpose, which deserve explication. There are, in fact, two aspects to the purpose. The stated purpose of the methodology is for teachers to create relevant and effective learning environments. The purpose of the study is to provide a means for teachers to use learning systems development techniques to develop classroom instruction. The two purposes do, in fact, interlock in this study, because learning systems development techniques have been built into the methodology. The building in of learning systems development techniques can be verified by comparing the methodology of Chapter VI with any of the flow charts of Hamreus, Kemp, Kaufman, and others listed in the annotated bibliography in Chapter II. All of the steps of the above authors are included, although in revised and modified format for use by teachers. Therefore, accomplishment of the methodology purpose of Chapter VI (process for teachers to create a relevant and effective learning environment for students) has built into it the accomplishment of the purpose of the study (method for teachers to use learning systems development in developing their classroom instruction).

When examining how well the methodology purpose was accomplished, it is important to recall the three steps of testing the methodology stated in Chapter VI. First was a test of knowledge items; second was a test of instructional development; and third was a test of implementation. Test results indicated overwhelming success for the first two

testing steps--virtually everyone was successful. This study concentrated on the first two steps only. However, some teachers reached the stage of implementation. The results at this third stage were more interesting. Most teachers were successful; however, quite a few problems surfaced which need further work. To this point, it has been verified that teachers can learn the skills, can develop instruction (create relevant and effective learning environments), and can implement this instruction, with help. Implementation (i.e., taking the instruction developed and installing it in the classroom) requires a good deal more work in terms of the methodology. The methodology has been successful as far as it has been developed, but this development stops just short of implementation.

The purpose of the study is included in the purpose of the methodology, since the methodology was designed to accomplish the purpose of the study (i.e., enabling classroom teachers to use learning systems development techniques to develop their classroom instruction). It is still useful, however, to separate the two purposes to see if both are accomplished. Critical examination reveals that teachers who utilize the methodology are, in fact, applying learning systems development techniques to the instruction they produce. The instruction contains a purpose, needs analysis, task analysis, behavioral objectives and criterion-referenced test items, a measurement of student characteristics, instructional materials keyed to objectives with supportive learning environments, validation, evaluation and feedback loops. This study has not yet reached the stage of implementation. Therefore, one would

say that the study has been most successful as far as it has gone; the job is not yet completed; successful completion appears to be a strong possibility.

Further Questions to Pursue

It is important to look ahead to the next steps in this process. While many issues need to be investigated, the following list represents the most immediate areas that need to be worked on to accomplish the purpose of this study. This list is based on test data, comments of teachers, and the personal opinion of the developer of the methodology. The list is numbered in order of accomplishment in the learning systems development process, and is in no way prioritized.

1. Implementation. As has been mentioned, implementation procedures have not been well worked out. This is the first priority, since the whole process becomes a set of useless academic formulas without a successful implementation component. Teachers face problems with the amount of time required to use this process. They need to develop learning systems development skills to a level where the skills can be performed quickly and competently. New forms of organization for curriculum development will be helpful (Haslip, 1973). Money is another problem. Alternative instructional materials, for instance, are more costly than a single set of materials for everyone. Also, attitudes of students, teachers and administrators are important and must change (see Chapter IV). Some groundwork has been laid in this area by the work of William

Phillip Gorth and Robert O'Reilly for implementation of CAM (Comprehensive Achievement Monitoring) and SPPED (System for Pupil Program Evaluation and Development).

2. Needs Analysis. These procedures should be tightened and further guidelines provided. At present, too much is left to teacher intuition. Procedures under development by the Cincinnati Public Schools, the Far West Regional Laboratory, and Phi Delta Kappa all show promise of providing useful techniques for adaptation in the area of needs analysis.

3. Affective Objectives. Teachers have little difficulty with cognitive and psychomotor objectives. However, many unanswered questions exist in the affective domain, particularly on measurement of affective objectives. Traditional rules of objective statement and measurement do not always apply in the affective area. Improvement in the methodology, at this point, must probably wait for further research. There are some interesting possibilities in this area, such as Operationalization of Fuzzy Concepts (Coffing, Hutchinson et al., 1971) and simulations. Other attempts in the field seem less productive, such as Popham's Vimcet filmstrip on "Affective Objectives" and Mager's (1972) book on goal analysis.

4. Student Characteristics. No serious problems arise when teachers measure student knowledges. However, aptitudes and attitudes are a bit more difficult to work with in terms of the questions: What aptitudes and attitudes are required for success in the

course? How can the aptitudes and attitudes already possessed by students be measured? This step is of vital importance for the development of efficient instruction. If students have aptitude or attitude problems that would interfere with learning objectives, then more depth to the instruction in the objectives would not improve the situation. What needs work is the aptitude or attitude deficiency. For further information in this area, refer to Merrill (1971), Part III, "Diagnosing Preinstructional Behavior."

5. Learning Differences. A whole theoretical field exists on relating student learning differences to the materials selected or produced to teach course objectives. This theoretical field is known as Aptitude Treatment Interaction. However, A.T.I. has not thus far provided conclusive data that can be turned to practical use by the classroom teacher. Articles such as those by Bracht (1970) and Cronbach (1967) lead one to believe that something worthwhile will emerge from this field in the not-too-distant future.

6. Student Management. This is an area that, at present, is not touched by the methodology. However, teachers will soon run into questions related to grouping, pacing, assignment of objectives, and the like when they begin large-scale implementation. At that point the methodology will need to deal with student management issues. A start in this area has been made by Allan and Gorth (1972) in SPPED Module 1400, entitled "Instructional Models (for student management)," where implications of group pacing,

regrouping, and individually-paced instruction are presented.

7. Decision-Making. This large area is loosely subsumed under evaluation. However, teachers are showing more and more interest in what decisions they make and how they can collect data to make their decisions (see CAM--Comprehensive Achievement Monitoring, and SPPED--System for Pupil Program Evaluation and Development). Soon it will be necessary to add to the methodology a procedure to help teachers with their decision-making. This is another area that will become more important after implementation.

8. Validation. Procedures for validating instruction that can be readily used by classroom teachers have been roughed out for CAM. However, these procedures rely heavily on computer assistance to aid the teacher in data management. Further procedures are necessary for teachers to learn the usefulness of validation (USAF Manual 50-2), and for teachers to learn how to use data for validation of all system components.

The above areas are by no means a conclusive list of all that needs to be done in the area of making learning systems development available for classroom teachers. However, the eight areas seem to be the most pressing at the moment to help teachers implement learning systems development.

It should be emphasized in closing that this study represents the conditions that exist at one point in time during a continuing effort to make learning systems development available to classroom teachers.

Efforts have been most successful to date and give every promise of success in the future. However, there is still a good deal of research and developmental work required before it can be assumed that a classroom teacher can utilize the developing methodology to implement learning systems development techniques to create relevant and effective learning environments for students.

A P P E N D I X

MINIMUM REQUIRED SKILLS FOR TEACHERS TO APPLY LEARNING SYSTEMS DEVELOPMENT

MINIMUM REQUIRED SKILLS FOR TEACHERS TO APPLY LEARNING SYSTEMS DEVELOPMENT

Field Survey (Including Objectives)

1. Identify or list the components of a field survey.

2. State the reason that a properly conducted needs analysis and task analysis are crucial to the development of instruction.

3. Given a situation describing data gathered prior to writing objectives, identify whether the data is complete enough to write objectives for a course of instruction.

4. List at least four sources to be tapped when conducting a needs analysis and task analysis.

5. Draw and label a hierarchical diagram to show what a task analysis structure should look like.

6. Given a task analysis diagram, fill in the steps with a hypothetical task analysis such as greasing a car, dissecting a frog, diagramming a sentence, etc.

7. Identify the relationship between a task analysis and behavioral objectives.

8. List the three major components of a well-written behavioral objective.

9. Given a series of five statements, identify the properly written behavioral objectives. (4 of 8)

10. Given a list, identify the definition of a criterion-referenced test item.

11. Given a list, identify the definition of a norm-referenced test item.

12. Given a situation, identify whether the testing is norm-referenced or criterion-referenced.

13. Given a criterion-referenced test item, write an appropriate behavioral objective.

14. Given a behavioral objective, write an appropriate criterion-referenced test item.

15. Choose a subject matter area of expertise, and write at least two behavioral objectives and matching criterion-referenced test items.

16. State the difference between a terminal objective (TO) and an enabling objective (EO).

17. Write a terminal objective and the enabling objectives necessary to accomplish the terminal objective; include criterion-referenced test items.

18. List at least three strategies for sequencing objectives; briefly explain (2-3 sentences) each strategy.

19. Write a one-paragraph explanation of the field survey step in instructional systems development.

Student Input

20. Identify the purpose of the student input step in instructional systems development.

21. Given a list of activities, identify those that should be done when determining student input.

22. Write a one-paragraph explanation of the student input step in instructional systems development.

Instructional Materials and Learning Environment

23. Identify the relationship between the objectives and the instructional methods.

24. Given a list, choose the correct reason(s) for including more than one type of instructional material for your objective.

25. Given an instructional situation and a list of instructional methods, choose the best method.

26. Identify the relationship between the learning environment and the instructional method.

27. List the characteristics of programmed instruction and briefly explain each.

28. Given four examples of programmed instruction, identify each as linear, branching, adjunct, or discrimination frame P.I.
[This was eliminated and never tested.]

29. Write a one-paragraph explanation of the strength and weakness of each type of programmed instruction.

30. Write a one-paragraph explanation of the role of the instructor when using programmed instruction.

31. List at least five constraints that may exist when choosing the learning environment.

32. Write a one-paragraph explanation of the instructional methods and learning environments step in instructional systems development.

Validation and Evaluation

33. Identify, from a series of statements, the purpose for validating instruction.

34. List and explain the steps in validating instruction.

35. List the three types of feedback received from CAM data.

36. Write a one-paragraph explanation of trend data.

37. List at least five decisions made by teachers where CAM is an aid in decision-making and explain how CAM aids teachers in making each of the decisions listed.

38. Draw a simple flowchart of mastery testing to include an explanation of the flowchart.

39. Write a one-paragraph explanation of feedback between the validation and instructional methods steps in the learning systems development approach.

40. Write a one-paragraph explanation of the validation and evaluation step in the learning systems development process.

Expansion of Major Skills

41. List four methods of performing a needs analysis and task analysis to include an explanation of the strengths and weaknesses of each method.

42. List three steps of behavioral objectives and describe each type.

43. List three methods of measuring student input.

44. List six instructional methods and include a general description of each method.

45. List four types of learning environments.

46. Describe the difference between internal and external validation.

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